PATENT SPECIFICATION (11) 1335378

1335378

DRAWINGS ATTACHED

(21) Application No. 53959/70 (22) Filed 12 Nov. 1970

(31) Convention Application No. 876 263 (32) Filed 13 Nov. 1969 in

(33) United States of America (US)

(44) Complete Specification published 24 Oct. 1973

(51) International Classification A61M 15/00; B65D 83/14

(52) Index at acceptance
A5T 420
F1R 3A3D11 3A3D12C 3A3D2 3A3D4D 3B12

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# (54) INHALATION RESPONSIVE AEROSOL DISPENSER

(71) We, RIKER LABORATORIES INC., a corporation organised under the laws of the State of Delaware, United States of America, of 19901 Nordhoff Street, Northridge, California, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates in general to an inhalation responsive dispenser for adminstering a metered quantity of a medicament to a patient in inhalation therapy, the medicament being carried by a propellant vehicle in an aerosol dispensing device.

The invention is principally concerned with an inhalation responsive dispenser which utilizes an aerosol dispensing device comprising a container equipped with a metering valve movable between a charging position and a discharging position, the metering valve valve receiving a metered charge from the container when in its charging position and discharging this metered charge when displaced into its discharging position. The metered charge is dispensed into a stream of air inhaled by the patient through a mouth-piece with which the dispenser is equipped.

Conventionally, an inhalation responsive dispenser of the type under consideration includes a housing in which the aerosol container is movably mounted, the metering valve engaging a seat in the housing which is provided with a passage for conveying a discharge from the metering valve to the mouthpiece. A main spring biases the container in a direction to position the metering valve in its discharging position. A charging apparatus opposes the action of the spring to enable the container to move into a position such that the metering valve may occupy its charging position. A latch releasably retains the charging apparatus and thus the container in the position corresponding to the charging position of the metering valve. An inhalation responsive means in the air passage leading to the mouthpiece releases the latch so that the main spring produces movement of the container into a position corresponding to the discharging position of the metering valve, whereby the latter discharges a metered amount of medicament from the container into the mouthpiece for inhalation by the patient.

One such type of inhalation responsive medicament dispenser preferred for the purposes of this invention, is adapted for use with an aerosol dispensing device equipped with a metering valve which discharges in response to inward movement of a member thereof, relative to the container, into an inner, discharging position from an outer, charging position, the device being equipped with an auxiliary spring which biases the movable member of the metering valve toward its outer charging position. The main spring hereinbefore referred to is a separate spring external of the container, for biasing the container toward the seat for the metering valve so as to bias a member of the metering valve inwardly relative to the container toward the discharging position of the metering valve, in opposition to the action of the auxiliary spring with which the aerosol dispensing device is equipped.

The present invention provides an inhalation-responsive dispenser, for use with an aerosol container having a metering valve for dispensing aerosol from the container, the metering valve having a member which is movable relative to the container between a charging and discharging position of the valve, the dispenser having a housing formed with an air passage therethrough terminating at a mouthpiece, the housing further being formed with a compartment for receiving such an aerosol container, a discharge passage between the compartment and the mouthpiece, a spring for acting on such a container in the compartment to bias the metering valve to its discharg-

ing position, a charging apparatus mounted on the housing for restraining the spring and permitting the metering valve of such a container in the compartment to adopt its charging position, a latch mounted on the housing for releasably retaining the charging apparatus in its spring-restraining position, and an inhalation-responsive device actuatable by air flowing through the air passage towards the mouthpiece for releasing the latch to the cause spring to bias the metering valve of such a container in the compartment to its discharging position to discharge a metered amount through the discharge passage to the mouthpiece, the dispenser further including a cover for the mouthpiece pivotally mounted on the housing for movement between an open and a closed position, and an actuator connected to the cover and responsive to movement thereof between the open and closed positions for activating the charging apparatus and the latch. It also provides an inhalation responsive dispenser having a housing formed with an air passage therethrough terminating at a mouthpiece, an aerosol dispensing device mounted in the housing and communicating with the mouthpiece for dispensing predetermined amounts of aerosol through the mouthpiece, members of the dispensing device being relatively movable between a charging and a discharging position, a spring for biasing the movable members of the dispensing device to the discharging position, charging apparatus mounted on the housing for opposing the action of said spring to afford movement of the relatively movable members of the dispensing device to the charging position, a latch mounted on the housing for releasably retaining the dispensing device in its charging position, and an inhalation responsive device in the air passage, and actuatable by air flowing therethrough toward the mouthpiece, for releasing the latch so that the spring produces relative movement between the members of the dispensing device to place the dispensing device in a discharging position whereby the dispensing device discharges a metered amount of aerosol through the mouthpiece, the dispenser further including a cover for the mouthpiece pivotally mounted on the housing for movement between an open and a closed position, and an actuator connected to the cover and responsive to movement thereof between the open and closed positions for activating the charging apparatus and the latch.

A preferred embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings wherein: Figure 1 is a longitudinal sectional view of an inhalation actuatable aerosol dispenser which embodies the invention, showing the cover of the dispenser closed; Figures 2 and 3 are sectional views respectively taken along the arrowed lines 2—2 and 3—3 of Figure 1; Figure 4 is a sectional view taken along the arrowed line 4—4 of Figure 2; Figure 5 is a sectional view taken along the arrowed line 5—5 of Figure 4; Figure 6 is a view similar to Figure 4, but showing the cover of the dispenser open and the dispenser ready for use; Figure 7 is a view similar to Figure 6, but showing the dispenser of the invention after it has been used to discharge a metered amount of medicament; Figure 8 is a view similar to Figure 7, but showing the cover in the process of being closed to again make the dispenser ready for use; Figure 9 is a fragmentary view duplicating a portion of Figure 8 and showing various parts of the positions they occupy just before the dispenser is completely made ready for use; Figure 10 is an exploded perspective view showing the parts of a charging means and a latch of the dispenser of the invention; Figure 11 is a perspective view of a partition forming part of the housing of the dispenser; and Figure 12 is a perspective view of an inhalation actuable vane forming part of the dispenser.

Throughout the drawings, the dispenser of the invention is designated generally by the numeral 20 and includes a housing 22 having therein a compartment 24 for an aerosol medicament-dispensing device 26 comprising a container 28 charged with a self-propelling liquid composition including as one component thereof any desired medicament suitable for inhalation therapy.

The aerosol container 28 is slidable upwardly and downwardly in a guideway 30 in a member 32 disposed in the compartment 24 and releasably secured therein by a suitable latch 34. The container 28 is provided at its lower end with a metering valve 36 engageable with a seat 38 communicating through a passage 40 with a mouthpiece 42 forming part of the member 32. As best shown in Figure 7, the mouthpiece 42 forms the terminus of an air passage, designated generally by the numeral 44, through the housing 22, the inlet 46 of the air passage 44 being adjacent the latch 34.

The metering valve 36 includes a housing member 48 within the container 28. Reciprocable in the housing 48 is a metering valve member 50 having a tubular stem 52 which projects from the housing 48 and the container 28 into the seat 38 through an annular seal 54. A lateral port 56 in the tubular stem 52 communicates with the interior of this stem 52. When the container 28 is in its upper position, Figure 6, the metering valve member 50 is in its charging position and the port 56 is located axially outwardly of the annular seal 54. When the container 28 is moved downwardly into the position of Figure 7, as will be described hereinafter, the metering valve member 50 is in its discharging position and the port 56 is axially inwardly of the annular seal 54.

The metering valve member 50 is biased axially outwardly toward its charging position, shown in Figure 6, by an auxiliary biasing member comprising a compression coil spring 58 seated at one end against an external collar on the metering valve member 50 and at other end against the housing member 48. The metering valve member 50 includes an axially-inwardly-extending pin 60 carrying a collar 62 which is engageable with an annular seal 64, when the metering valve is in its discharging position, Figure 7, to close a passage 66 interconnecting the interior of the housing 48 and the interior of the container 28. When the container 28 is in the position corresponding to the charging position, Figure 6, of the metering valve 36, the collar 62 disengages the annular seal 64 to open the passage 66.

Considering the operation of the metering valve 36 briefly, when the container 28 is in the position corresponding to the charging position of the metering valve member 50, as shown in Figure 6, a metered charge may flow from the interior of the container 28 into the housing 48 through the passage 66. Upon subsequent movement of the container 28 into the discharging position of the metering valve member 50, as shown in Figure 7, the metered charge is discharged from the interior of the housing 48 through the port 56 and the tubular stem 52 into the passage 40 leading to the mouthpiece 42. Under such circumstances, the collar 62 closes the passage 66 to prevent further flow from the interior of the container 28. Conversely, when the metering valve member 50 was in its charging position, Figure 6, the port 56 was located axially outwardly of the annular seal 54 to disconnect the tubular stem 52 from the interior of the housing 48.

The compression coil spring 58 forming part of the metering valve 36 biases the aerosol container 28 upwardly into its Figure 6 position, corresponding to the charging position of the metering valve 36. However, a main spring assembly 70 is capable of overcoming the spring 58 to displace the container 28 downwardly into its Figure 7 position, corresponding to the discharging position of the metering valve member 50. The main spring assembly 70 comprises a relatively heavy coil spring 72 acting in compression between the upper end wall of the housing 22 and a driver 74 movable upwardly and downwardly along tracks 76, Figure 3. The driver 74 transmits the force of the spring 72 to the upper, closed end of the aerosol container 28 to bias it downwardly into its discharing position, Figure 7.

The dispenser 20 includes charging apparatus 80 for placing the aerosol dispensing device 26 in its charging condition in opposition to the action of the spring 72, which biases it toward its discharging condition. More particularly, the charging apparatus 80 opposes the action of the spring 72 to enable the spring 58 of the metering valve 36 to displace the container upwardly away from its seat 38 into a position corresponding to the charging position of the metering valve member 50, Figure 6.

The charging apparatus 80 includes an L-shaped charging lever 82 having its shorter arm pivotally connected to the housing 22 at 84. The charging lever 82 extends through an aperture 86 in the driver 74 and is engageable with a knife edge 88 forming the upper edge of the aperture. As will be apparent, when the charging lever 82 is pivoted upwardly, it acts through the driver 74 to compress the spring 72 and permit the spring 58 in the metering valve 36 to displace the container 28 upwardly into the position thereof corresponding to the charging position of the metering valve member 50. The manner in which the charging lever 82 is pivoted upwardly will be considered hereinafter.

Alongside the compartment 24 for the aerosol dispensing device 26, the separated therefrom by a partition 90, are an actuator compartment 92 and a vane compartment 94, Figure 5. The actuator and vane compartments 92 and 94 are separated by an irregular partition 96, shown in perspective in Figure 11.

As will be clear from Figure 7, the lower end of the vane compartment 94 forms a part of the air passage 44 leading to the mouthpiece 42. The vane compartment contains an inhalation responsive device 98 which, as will be described hereinafter, permits the aerosol dispensing means 26 to deliver a metered charge to the mouthpiece 42 for inhalation by the user of the dispenser 20.

More particularly, the inhalation responsive device 98 includes a depending vane 100 disposed in and closely fitting the vane compartment 94. The vane 100 is provided at its upper end with a pivot shaft 102 suitably pivotally mounted in the housing 22 so that the vane 100 can swing back and forth in the vane compartment 94 between a latching position, Figure 6, and a latch-releasing position, Figure 7. The pivot shaft 102 is provided thereon within the actuator compartment 92 with a flat 104 for a purpose to be described. It will be apparent that, when the patient inhales through the mouthpiece 42, the flow of air through the passage 44, as shown in Figure 7, pivots the vane 100 from its latching position to its latch-releasing position.

The dispenser 20 further includes a latch assembly 110 in the actuator compartment 92 for releasably retaining the aerosol dispensing device 26 in its charging condition, the latch assembly 110 being releasable by the inhalation responsive device 98 to permit the main spring assemby 70 to place the aerosol container 28 in its discharging condition, whereby

it discharges a metered amount into the stream of air being inhaled by the patient through the mouthpiece 42. Considering the latch assembly 110 more specifically, it includes a generally upright latch 112 having at its lower end a pivot shaft 114 seated in a sem-cylindrical bearing 116 carried by the partition 96 and one sidewall of the housing 22. The latch 112 is provided at its upper end with a hook 118 and is rotatable between a first position at which the hook 118 is separated from the vane pivot shaft 102 (Figure 7) and a second position at which the hook 118 is in contact with the vane pivot shaft 102 (Figures 3, 4 and 6). The hook 118 is adapted to hook over the flat on the vane pivot shaft 102, as shown in Figure 6, when the vane 100 is in its latching position. When the vane 100 is pivoted into its latch-releasing position, Figure 6, by the user's inhalation, the vane pivot shaft 102 is rotated sufficiently to permit an end 120 of the hook 118 to slide across the flat 104 to release the latch assembly 110. Conversely, as shown in Figure 9, the hook end 120 may slide across the flat 104 in engaging the latch 112 with the vane pivot shaft 102, prior to pivoting the vane 100 into its latching position.

The latch 112 and the charging lever 82 are interconnected within the actuator compartment 92 by a link 124 pivotally connected to the latch 112 intermediate its ends at 126 and to the charging lever 82 at its free end, at 128. The relationship between the link 124, the charging lever 82 and the latch 112 is such that as the latch is hooked over the vane pivot shaft 102, Figure 6, the charging lever 82 is also pivoted upwardly into a position corresponding to the charging position of the metering valve 36. Thus, the latch assembly 110 releasably retains the charging apparatus 80 in a position corresponding to the charging position of the metering valve 36. The charging apparatus 80 and the latch assembly 110 are placed in their foregoing locked positions by an actuator 130 in the actuator compartment 92, such actuator also serving to place the vane 100 in its latching position so that the hook 118 of the latch 112 is hooked over the flat of the vane pivot shaft 102.

Considering the actuator 130 in more detail, it is pivotally connected at 132 to a cover 134 for the mouthpiece 42. The cover 134 is pivotally connected to the housing 22, at 136, for pivotal movement between a closed position, Figures 1 to 5, and an open position, Figures 6 and 7.

The actuator 130 comprises a bifurcated cam 139 which extends upwardly from the cover 134 into the actuator compartment 92 and which terminates in a first cam segment 140, and a second cam segment 142. The cam segment 140, as best shown in Figures 7 and 8, engages a pin 144 on the latch 112 to pivot the latch 112 from its first position to its second position and into latching engagement with the vane pivot shaft 102, as will be apparent by considering Figures 8, 9 and 4 in that order. This occurs, as will be evident from the drawings, in response to closing movement of the cover 134. At the same time, the link 124 acts on the charging lever 82 to pivot it upwardly into a position corresponding to the charging position of the metering valve 36. While these events are taking place, the cam segment 142 engages an arm 146 on the vane pivot shaft 102, as shown in Figure 9, to pivot the vane 100 into its latching position, Figure 4. The cam segment 142 pivots the vane 100 into its latching position as the end 120 of the hook 118 moves across the flat 104 on the vane pivot shaft 102. Consequently, as the vane 100 is displaced into its latching position, the flat of the vane pivot shaft 102 is rotated into hooked relation with the latch hook 118, as shown in Figure 4, and also in Figure 6. As further shown in Figure 6, once the latch 112 has entered into hooked engagement with the flat of the vane pivot shaft 102, the cover 134 may be opened to disengage the cam segments 140 and 142 from the latch 112 and the vane 100.

Referring particularly to Figure 4, the cam segment 142 is provided thereon with a projection 148 which is engageable with one edge of the semi-cylindrical bearing 116 to releasably retain the actuator 130 in a position to hold the cover 134 closed. Upon opening the cover 134 manually, the projection 148 disengages the bearing 116.

It will be assumed initially that the various parts of the dispenser 20 are in the position shown in Figure 4 of the drawings, wherein the dispenser is cocked with the aerosol dispensing device 26 in its charging condition. More particularly, the latch assembly 110 retains the charging apparatus 80 in a position corresponding to the charging position of the metering valve 36, and also retains the vane 100 in its latching position. Further, the cover 134 is closed to maintain the cam segments 140 and 142 respectively in engagement with the pin 144 on the latch 112 and the arm 146 on the vane pivot shaft 102.

When the dispenser 20 is to be used, the cover 134 is opened, as shown in Figure 6. This makes the mouthpiece 42 accessible, and also disengages the cam segments 140 and 142 from the latch pin 144 and from the vane-pivot-shaft arm 146, respectively.

Next, the patient places the mouthpiece 42 in his mouth and inhales therethrough, thereby causing air to flow through the passage 44, as shown in Figure 7. This air flow causes the vane 100 to pivot into its latch-releasing position, as shown in Figure 7. Very little flow is required to accomplish this since the only thing preventing movement of the vane 100 from its latching position to its latch-releasing position is friction between the hook

118 and the vane pivot shaft 102 and friction between the vane pivot shaft and its bearings. Pivoting of the vane 100 toward its latch-releasing position aligns or registers the flat 104 on the vane pivot shaft 102 with the hook end 120, whereby the hook 118 may disengage the vane pivot shaft 102, under the impetus provided by the main spring 72. The latter, acting through the driver 74, propels the aerosol container 28 into a position corresponding to the discharging position of the metering valve 36. Thus, a metered charge is delivered to the mouthpiece 42 for inhalation by the user in the same breath used to trigger the dispenser 20. In other words, the act of inhaling results in substantially simultaneous triggering of the dispenser 20 and inhalation of the metered charge dispensed thereby.

Subsequently, the cover 134 is returned to its closed position, thereby causing the various parts to move from the positions shown in Figure 7 through the positions shown in Figures 8 and 9 back to those shown in Figure 4. This prepares the dispenser 20 for subsequent reuse when necessary.

Although an exemplary embodiment of the invention has been disclosed for purposes of illustration, it will be understood that the various changes, modifications and substitutions may be incorporated in such embodiment.

WHAT WE CLAIM IS:—

1. An inhalation-responsive dispenser, for use with an aerosol container having a metering valve for dispensing aerosol from the container, the metering valve having a member which is movable relative to the container between a charging and discharging position of the valve, the dispenser having a housing formed with an air passage therethrough terminating at a mouth-piece, the housing further being formed with a compartment for receiving such an aerosol container, a discharge passage between the compartment and the mouthpiece, a spring for acting on such a container in the compartment to bias the metering valve to its discharging position, a charging apparatus mounted on the housing for restraining the spring and permitting the metering valve of such a container in the compartment to adopt its charging position, a latch mounted on the housing for releasably retaining the charging apparatus in its spring-restraining position, and an inhalation-responsive device actuatable by air flowing through the air passage towards the mouth-piece for releasing the latch to cause the spring to bias the metering valve of such a container in the compartment to its discharging position to discharge a metered amount through the discharge passage to the mouth-piece, the dispenser further including a cover for the mouthpiece pivotally mounted on the housing for movement between an open and a closed position, and an actuator connected to the cover and responsive to movement thereof between the open and closed positions for activating the charging apparatus and the latch.

2. An inhalation-responsive dispenser according to claim 1, for use with an aerosol container having a metering valve for dispensing aerosol from the container, the metering valve having a member which is movable relative to the container between a charging and a discharging position of the valve and which is biassed outwardly of the container towards the charging position of the valve, wherein the compartment has a seat for the outwardly urged member of such a container, the seat being formed with the discharge passage, the spring being mounted to bias such a container in the compartment towards the seat and to the discharging position of the metering valve, and the inhalation-responsive device including a vane which is movably mounted in the housing to be movable in response to air flowing to the mouth-piece from a latching position for retaining the latch in a position for retaining the charging apparatus in its spring restraining position to a release-position for releasing the latch.

3. An inhalation responsive dispenser according to claim 1 or claim 2 wherein the actuator for activating the charging apparatus and latch is responsive to movement of the cover from the open to the closed position.

4. An inhalation responsive dispenser according to claim 2, or according to claims 2 and 3 wherein the vane has at one end a pivot shaft formed with a flat thereon, the shaft being journaled in the housing and being rotatable with the vane between the latching and releasing positions, and wherein the latch is pivotally mounted on the housing for movement between first and second positions and includes a hook engageable with the pivot shaft at the second position of the latch, the hook having an end slidable across the flat to release the latch when the vane is in the releasing position.

5. An inhalation responsive dispenser according to claim 4 wherein the actuator is positioned for rotating the pivot shaft when the latch is in the second position to engage the hook with the pivot with the pivot shaft with the end of the hook out of register with the flat upon movement of the cover from the open to the closed position.

6. An inhalation responsive dispenser according to claim 2 wherein the vane is mounted for pivotal movement between the latching and latch-releasing positions, and the actuator is positioned for pivoting the vane into the latching position upon movement of the cover from the open to the closed position.

7. An inhalation responsive dispenser according to any of claims 4 to 6 wherein the charging apparatus includes a charging lever pivotally mounted at one end on the housing, the other end of the lever being

connected to the latch, the charging lever being connected intermediate its ends to the spring and being movable to and from its spring-restraining position in response to the latch being moved between the first and second positions.

8. An inhalation responsive dispenser according to claim 7 wherein the actuator includes a cam engageable with the latch to move the latch from the first to the second position, and engageable with the vane to move the vane from the release position to the latching position upon the latch reaching the second position in response to the movement of the cover from the open to the closed position.

9. An inhalation responsive dispenser according to any preceding claim wherein the actuator includes a projection releasably engageable with the housing for latching the cover in its closed position.

10. An inhalation responsive dispenser having a housing formed with an air passage therethrough terminating at a mouthpiece, an aerosol dispensing device mounted in the housing and communicating with the mouthpiece for dispensing predetermined amounts of aerosol through the mouthpiece, members of the dispensing device being relatively movable between a charging and a discharging position, a spring for biasing the movable members of the dispensing device to the discharging position, charging apparatus mounted on the housing for opposing the action of said spring to afford movement of the relatively movable members of the dispensing device to the charging position, a latch mounted on the housing for releasably retaining the dispensing device in its charging position, and an inhalation responsive device in the air passage, and actuatable by air amount of aerosol through the mouthpiece, for releasing the latch so that the spring produces relative movement between the members of the dispensing device to place the dispensing device in a discharging position whereby the dispensing device discharges a metered amount of aersol through the mouthpiece, the dispenser further including a cover for the mouthpiece pivotally mounted on the housing for movement between an open and a closed position and an actuator connected to the cover and responsive to movement thereof between the open and closed positions for activating the charging apparatus and the latch.

11. An inhalation responsive dispenser according to claim 10 wherein the aerosol dispensing device includes an aerosol container and an aerosol metering valve communicating with said container, the valve having the said members relatively movable between the charging and discharging positions.

12. An inhalation responsive dispenser according to claim 11 wherein one of the members of the metering valve is biased outwardly of the container toward the charging position of the metering valve, wherein the housing includes a seat for the outwardly urged member, the seat being formed with a discharge passage for conveying a discharge from the metering valve to the mouthpiece, wherein the spring is mounted between the container and the housing to bias the container toward the seat and the discharging position of the metering valve, and wherein the inhalation responsive device includes a vane movably mounted in the housing, the vane being positioned in the air passage and being movable in response to air flowing to the mouthpiece from a latching position for retaining the latch in a position for retaining the metering valve in its charging position to a releasing position for releasing the latch.

13. An inhalation responsive dispenser according to claim 10 or claim 12 wherein the actuator for activating the charging apparatus and the latch is responsive to movement of the cover from the open to the closed position.

14. An inhalation responsive dispenser according to claim 12 or 13 wherein the vane has at one end a pivot shaft formed with a flat thereon, the shaft being journaled in the housing and being rotatable with the vane between the latching and releasing positions, the latch being pivotally mounted on the housing for movement between a first and a second position and including a hook engageable with the pivot shaft at the second position of the latch, the hook having an end slidable across the flat to release the latch when the vane is in the releasing position.

15. An inhalation responsive dispenser according to claim 14 wherein the actuator is positioned for rotating the pivot shaft into a position to engage the hook with the pivot shaft with the end of the hook out of register with the flat upon movement of the cover from the open to the closed position.

16. An inhalation responsive dispenser according to claim 12 wherein the vane is mounted for pivotal movement between the latching and latch releasing positions, and the actuator is positioned for pivoting the vane into the latching position upon movement of the cover from the open to the closed position.

17. An inhalation responsive dispenser according to claim 14 wherein the charging apparatus includes a charging lever pivotally mounted at one end on the housing, the other end of the lever being connected to the latch, the charging lever being connected intermediate its ends to the spring and being movable to afford movement of the metering valve between the discharging and charging positions in response to the latch being moved between the first and second positions.

18. An inhalation responsive dispenser according to claim 17 wherein the actuator

includes a cam engageable with the latch to move the latch from the first to the second position and engageable with the vane to move the vane from the releasing position to the latching position upon the latch reaching the second position in response to the movement of the cover from the open to the closed position.

19. An inhalation responsive dispenser according to any of claims 10 to 18 wherein the actuator includes a projection releasably engageable with the housing for latching the cover in its closed position.

20. An inhalation responsive dispenser, for use with an aerosol container and substantially as described herein with reference to the accompanying drawings.

21. A combined inhalation responsive dispenser and aerosol container substantially as hereinbefore described with reference to the accompanying drawings.

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Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1973.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

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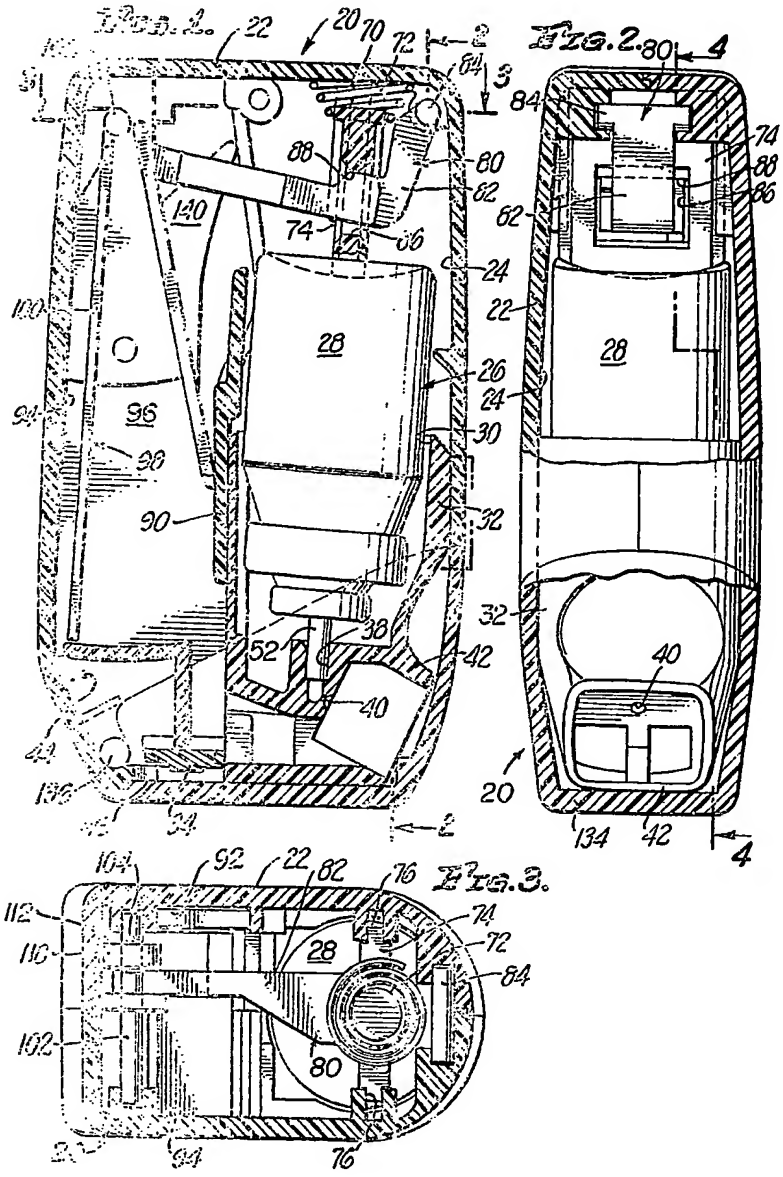

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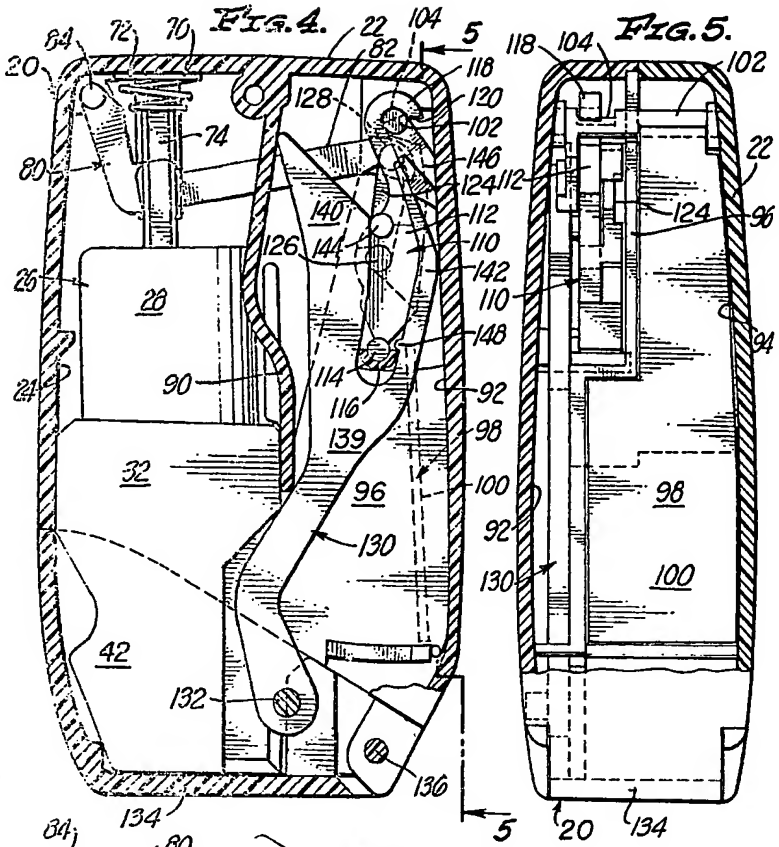


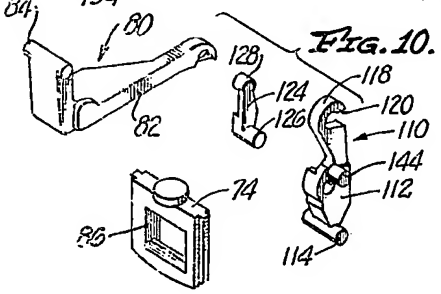

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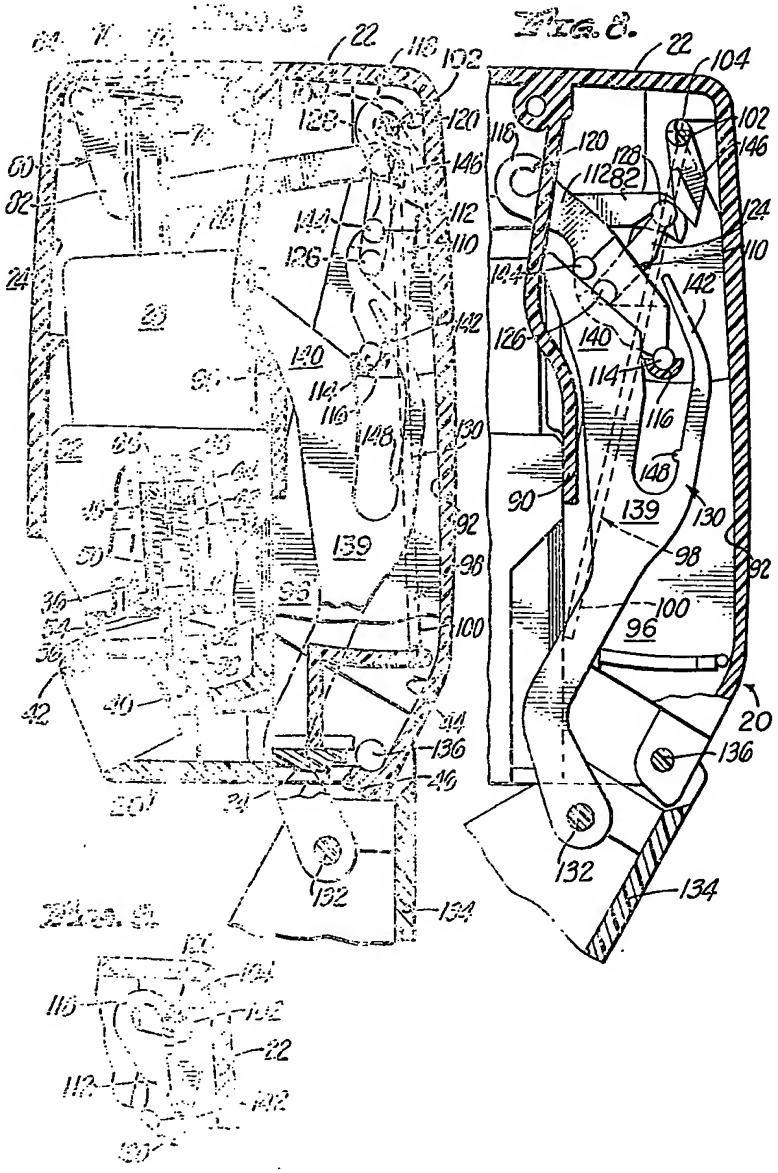

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FIG. 7.

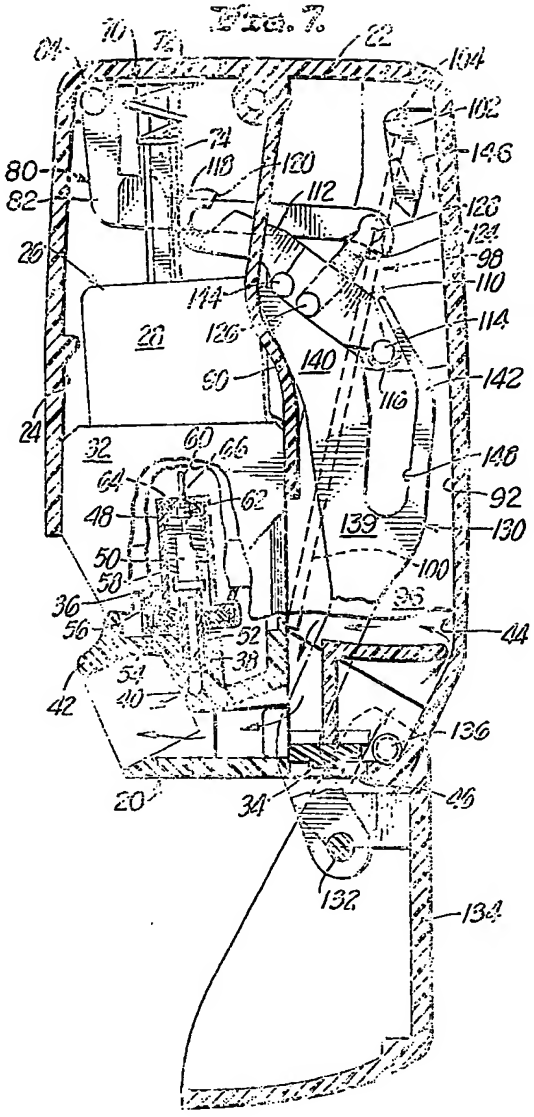


FIG. 11.

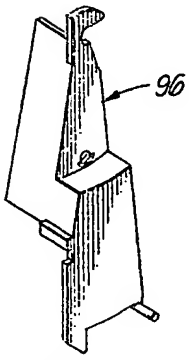


FIG. 12.